

# Bi-cropping fodder maize in an existing (grass)clover sward

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**Abstract** – Organic cultivation of fodder maize is still considered to be difficult. Weed pressure, soil structure degradation during harvest and low nutrient efficiency are some of the common problems. Directly sowing maize in a (grass)clover sward using specialized drilling machines can solve these problems. In a bi-cropping experiment under organic conditions we found similar yields as the reference treatment (ploughing) when the maize was sown in a clover sward, the roots of the remaining sward were cut one week after sowing and an additional fertiliser was applied.<sup>1</sup>

## INTRODUCTION

The cultivation of fodder maize under organic conditions in the Netherlands is still considered to be challenging by most livestock farmers. Weed pressure is normally very high and the late harvest may result in a deterioration of soil structure. Furthermore fodder maize is often cultivated after ploughing a perennial grassclover sward causing nitrate leaching due to high mineralization. In conventional farming no-till systems were developed to overcome these difficulties (Bohren, 2000 & 2002 and Zihlmann, 2002). As these systems are accompanied with the use of herbicides, these methods are still hardly used under organic conditions. In an attempt to make the no-till system suitable for organic agriculture a project was started in the Netherlands in 2004. The main objective was to see whether similar yields could be attained in an organic no-till system, preferably keeping the existing grassclover or clover sward alive both for a good weed suppression and reduced leaching. In the experiment of 2005 several methods were used to reduce the competition of the sward with the fodder maize in an attempt to get as little yield reduction as possible.

## MATERIALS AND METHODS

The experiment was carried out on a dairy farm in Helvoirt (Brabant). The soil is a sandy soil with a pH-KCl of 5,9 and organic matter content of 3,7%. The fodder maize was sown in a grass-white clover sward and a pure white clover sward. Maize sown in a ploughed plot on the same field was taken as reference treatment. All maize was sown between May 19<sup>th</sup> and May 25<sup>th</sup>. The sowing was done by two types of machines: a disc coultter combined with a dockfoot hoe and two strip rotary cultivators. The disc coultter only cuts and lifts the sward before sowing, but the sward is pushed back to the original

position after that. The two rotary cultivators leave a strip of bare soil where the maize is sown. The (grass)clover swards were either kept undisturbed, were mowed 2-3 times or the roots were cut at a depth of 4-6 cm one week after sowing (subsoiled). Half the treatments were fertilised with 900 kg feather meal/ha (120 kg N-total/ha) whereas the other half were not fertilised. The reference field was fertilised with 50 t slurry/ha (175 kg N-total/ha) prior to ploughing. As the experiment was still largely an inventory study, the experiment was laid out in a split plot design without replication. During the course of the season the nitrogen mineralization was measured by taking soil samples in the row of maize and between the rows of maize at regular intervals mainly at the first month after sowing. Plant development was measured at the half of the season by measuring the plant height. At harvest, the dry matter yield was determined for each plot.

## RESULTS

### *Survival of the swards after cutting the roots*

Within one week all the subsoiled clover died due to drought. In the grassclover sward all the clover died as well, but the grass managed to recover. After two weeks new grass roots were found in the subsoil.

### *Water competition*

Three weeks after sowing a dry spell started with high temperatures and a lot of sunshine. After one week of drought all the plots with a living (grass)clover sward showed signs of wilting in the maize. The maize sown with the disc coultter showed water stress the earliest, but maize sown in rotary cultivated soil had severe water competition from the swards as well. Plots where the (grass)clover roots were cut showed little water stress symptoms.

### *Nitrogen availability*

The nitrogen mineralization from incorporated residues in the rotivated strips started within one week after sowing. Nitrate levels in the rotivated strips were comparable to the levels in the reference field (figure 1). The mineralization in the grassclover strips was a bit lower than in the clover. The mineralization in the maize row sown with the disc coultter was much lower than the mineralization in the ploughed or rotivated soil.

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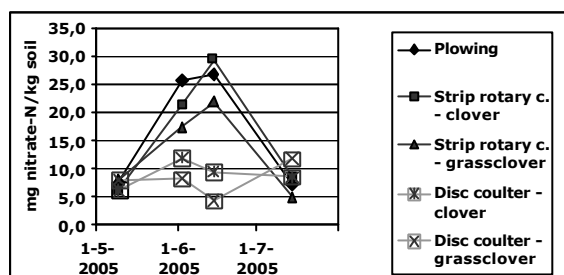


Figure 1 Nitrate levels in the topsoil (0-25 cm) in the maize row

For the first three weeks the plant N-uptake in the maize row did not exceed the N-mineralization in the strip cultivated plots and in the reference field, resulting in a rise in soil nitrate levels.

The nitrate levels in the soil between the rows of maize were lower in the first three weeks after sowing in all the bi-cropping plots compared to the reference field. Although immediate mineralization of the (grass)clover sward was apparent in the plots where the roots were subsoiled (figure 2), nitrate levels did not reach those high levels as in the ploughed field. Little difference was seen between mowing and not mowing the (grass)clover (results not shown).

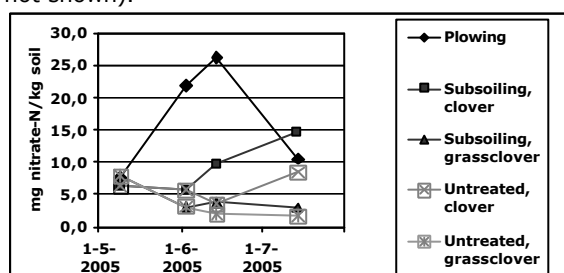


Figure 2 Nitrate levels in the topsoil (0-25 cm) between the maize rows

#### Weed development

The reference field was weed harrowed several times during the season. In the bi-cropped maize no weed management was applied other than mowing the swards in some treatments. Considerable weed development was seen in the rotary cultivated strips. The wider the cultivated strip, the more weeds developed. Especially the taller weeds like *Chenopodiaceae* and *Solanum nigrum* grew so big that they probably caused a reduction in yield for the maize. Between the maize rows no weeds developed where the sward was untreated or mowed. The subsoiled sward did show some weed development, especially the clover sward where no clover survived.. However it was mainly *Stellaria media* that emerged two weeks after subsoiling and this weed did not pose a threat to the development of the maize.

#### Plant development and yields

Halfway the season all the bi-cropped maize was smaller than the maize in the ploughed field. The best performing treatments were the ones sown in a rotary cultivated strip, where the remaining sward was subsoiled. The plant height in these treatments was only 70-80% of the height in the reference field. Relative comparison between the treatments showed that grassclover did not considerably differ from

clover treatments. Mowing did not have a considerable effect on plant height either. The strongest effect came from subsoiling.

	Mid season 12-7 plant height	Harvest 3-10 Yield
mowing vs untreated	1,08	1,50
subsoiling vs untreated	1,41	1,80
fertilised vs non fertilised	1,23	1,48
clover vs grassclover	1,14	1,60

Table 1 Average ratio between treatments in plant heights and DM yield

At harvest, differences in yield between clover and grassclover and the yield increase due to mowing became more apparent. All treatments resulted in an increase of yield and subsoiling still gave the biggest increase in yield.

Sowing	Between rows	Clover		Grassclover	
		Non-fert.	Fert.	Non-fert.	Fert.
rotary c.	Untreated	42	62	17	62
	Mowing	65	87	43	67
	Subsoiling	79	100	48	75
disc c.	Untreated	42	53	12	23
	Mowing	56	69	23	46
	Subsoiling	69	83	31	65

Table 2 Yield index for the bi-cropping treatments. 100 is the yield in the ploughed field (=16,8 t DM/ha)

#### CONCLUSIONS AND FURTHER RESEARCH

Bi-cropping fodder-maize in a clover sward can give similar yields as traditionally grown maize, but this does not seem to be possible when keeping the sward alive. To prevent water competition of an undisturbed sward in the beginning of the growing season cutting the roots of the sward (subsoiling) seems to be an effective measure. Even when the remaining sward was killed by subsoiling, mineralization between the rows was delayed, preventing high nitrate levels and the risk of leaching in the beginning of the growing season. Weed development between the rows can be kept at an acceptable level even when the sward is killed in the beginning of the growing season. Weed development in the maize row still needs increased attention. Further research needs to be done to see whether similar results can be obtained in a grassclover sward and if nitrate leaching is not postponed to the winter following the harvest.

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